

Claims

1. A transport layer relay method for terminating each of a plurality of transport layer connections in the transport layer and relaying data flow on each of said transport layer connections to respectively separate transport layer connections; wherein the total transmission rate of relay connections that are being used for relay is determined, and said total transmission rate is divided for allotment as the transmission rates of relay connections that are being used in relay.

2. A transport layer relay method according to claim 1, wherein said total transmission rate is determined in accordance with the number of transport layer connections that are being relayed and the congestion conditions of the network through which the relay connections pass.

3. A transport layer relay method according to claim 1, wherein said total transmission rate is determined in accordance with the number of transport layer connections that are being relayed and the congestion conditions of the network through which relay connections pass such that desired effective rates are attained for all relay connections that are being used in relay.

4. A transport layer relay method according to claim 1, wherein said total transmission rate is determined in accordance with the number of transport layer connections that are relayed and the congestion conditions of the network through which relay connections pass such that effective rates of

5 all relay connections that are being used for relay can be attained while conferring priorities to traffic other than relay connections that share bottlenecks with relay connections.

5. A transport layer relay method according to claim 1, wherein said total transmission rate is divided and allotted to transmission rates of each of said relay connections depending on application information in said data flow on each of said relay connections.

5

6. A transport layer relay method according to claim 1, wherein the results of estimating, by means of measurement packets, the congestion conditions of a network through which relay connections pass are also used to determine said total transmission rate.

5

7. A transport layer relay method according to claim 1, wherein the results of estimating, by means of relay packets, the congestion conditions of a network through which relay connections pass are also used to determine said total transmission rate.

5

8. A transport layer relay device, wherein said transport layer relay device includes a plurality of terminal-side connection termination units for terminating each of a plurality of transport layer connections with terminals in a transport layer and a plurality of interdevice connection termination units for terminating each of a plurality of transport layer connections between transport layer relay devices for relaying transport layer data between each of said

5

terminal-side connection termination units and each of said interdevice connection termination units; wherein:

10 said interdevice connection termination units transmit in accordance with
a transmission rate that is reported from a transmission rate control unit;
and
the transmission rate control unit determines the total transmission rate
of all interdevice connection termination units that are used in relay,
divides said total transmission rate, and reports the respective rates that
15 have been divided and allotted to each said interdevice connection
termination unit that is being used in relay.

9. A transport layer relay device according to claim 8, wherein said
transmission rate control unit determines said total transmission rate in
accordance with the number of transport layer connections that are being
relayed and the connection-specific congestion information that is reported
5 from each interdevice connection termination unit.

10. A transport layer relay device according to claim 8, wherein said
transmission rate control unit determines said total transmission rate in
accordance with the number of transport layer connections that are being
relayed and connection-specific congestion information that is reported from
5 each interdevice connection termination unit such that the effective rates of all
relay connections that are being used in relay attain a desired rate.

11. A transport layer relay device according to claim 8, wherein said
transmission rate control unit determines said total transmission rate in

accordance with the number of transport layer connections that are being relayed and connection-specific congestion information that is reported from each interdevice connection termination unit such that said effective rates of all relay connections that are being used in relay are attained while conferring priorities to traffic other than relay connections that share bottlenecks with relay connections.

12. A transport layer relay device according to claim 8, further comprising:

an application information analysis unit for, when relaying transport layer data between each of said terminal-side connection termination units and each of said interdevice connection termination unit, analyzing application information in said transport layer data; wherein said transmission rate control unit divides and allots said total transmission rate among the transmission rates of each of said relay connections based on application information from said application information analysis unit.

13. A transport layer relay device according to claim 8, further comprising:

a network condition estimation unit for, based on measurement packets, inferring congestion conditions of the network through which relay connections pass; wherein said transmission rate control unit also uses the results inferred by said network condition estimation unit to determine said total transmission rate.

14. Any one of transport layer relay devices according to claim 8,
further comprising:

5 an inline measurement unit for, by means of packets that are relayed,
inferring congestion conditions of the network through which relay
connections pass;
wherein said transmission rate control unit also uses the results inferred
by said inline measurement unit to determine said total transmission rate.

15. A transport layer relay method for terminating each of a plurality
of transport layer connections in respective transport layers and then grouping
data flows on each of said transport layer connections into one transport layer
connection for relaying, wherein:

5 the total transmission rate of the relay connections is determined, and
the data flows from each of said transport layer connections are grouped
to a relay connection in accordance with divided rates of said total
transmission rate.

16. A transport layer relay method according to claim 15, wherein
said total transmission rate is determined in accordance with the number of
transport layer connections that are being relayed and congestion conditions of
the network through which relay connections pass.

5 17. A transport layer relay method according to claim 15, wherein
said total transmission rate is determined in accordance with the number of
transport layer connections that are being relayed and congestion conditions of

the network through which relay connections pass such that desired effective
5 rates are attained for all relay connections that are being used in relay.

18. A transport layer relay method according to claim 15, wherein
said total transmission rate is determined in accordance with the number of
transport layer connections that are being relayed and congestion conditions of
the network through which relay connections pass such that an effective rate of
5 all relay connections that are being used in relay can be attained while
conferring priorities to traffic other than relay connections that shares
bottlenecks with the relay connections.

19. A transport layer relay method according to claim 15, wherein
data flows from each of said transport layer connections are grouped to a relay
connection in accordance with rates for which said total transmission rate has
been divided depending on application information in said data flows.
5

20. A transport layer relay method according to claim 15, wherein the
results of estimating, by means of measurement packets, congestion
conditions of the network through which relay connections pass are also used
to determine said total transmission rate.
5

21. A transport layer relay method according to claim 15, wherein
results of estimating, by means of relay packets, congestion conditions of the
network through which relay connections pass are also used to determine said
total transmission rate.
5

22. A transport layer relay device having: a plurality of terminal-side connection termination units for terminating transport layer connections with terminals in the transport layer; one interdevice connection termination unit for terminating a transport layer connection between transport layer relay devices;
5 and an MUX-DEMUX unit for grouping transport layer data from each of said terminal-side connection termination units and transferring to said interdevice connection termination unit; wherein:

10 said interdevice connection termination unit transmits in accordance with a total transmission rate that is reported from a transmission rate control unit;

said MUX-DEMUX unit groups data from terminal-side connection termination units in accordance with the distribution of rates that is reported from the transmission rate control unit; and
the transmission rate control unit determines and reports the total
15 transmission rate of said interdevice connection termination unit and reports the distribution of rates obtained by dividing said total transmission rate to said MUX-DEMUX unit.

23. A transport layer relay device according to claim 22, wherein said transmission rate control unit determines said total transmission rate in accordance with the number of transport layer connections that are being relayed and congestion information of connections that are reported from the
5 interdevice connection termination unit.

24. A transport layer relay device according to claim 22, wherein said transmission rate control unit determines said total transmission rate in

accordance with the number of transport layer connections that are being relayed and congestion information of connections that is reported from the interdevice connection termination unit such that the effective rate of relay connections attains a desired rate.

25. A transport layer relay device according to claim 22, wherein said transmission rate control unit determines said total transmission rate in accordance with the number of transport layer connections that are being relayed and congestion information of connections that is reported from each interdevice connection termination unit such that the effective rate of relay connections is attained while conferring priorities to traffic other than relay connections that shares bottlenecks with relay connections.

26. A transport layer relay device according to claim 22, further comprising an application information analysis unit for analyzing application information in transport layer data when transport layer data are transferred between each of said terminal-side connection termination unit and said MUX-DEMUX unit;

wherein said transmission rate control unit divides said total transmission rate and determines the distribution that is reported to said MUX-DEMUX unit based on application information from said application information analysis unit.

27. A transport layer relay device according to claim 22, further comprising a network condition estimation unit for estimating, by means of

measurement packets, congestion conditions of the network through which relay connections pass;

5 wherein said transmission rate control unit also uses the results inferred by said network condition estimation unit to determine said total transmission rate.

28. A transport layer relay device according to claim 22, further comprising an inline measurement unit for estimating, by means of packets that are relayed, congestion conditions of the network through which relay connections pass;

5 wherein said transmission rate control unit also uses the results inferred by said inline measurement unit to determine said total transmission rate.

29. A transport layer relay method according to claim 1, wherein, when establishing a new transport layer connection, said total transmission rate is determined, said total transmission rate is divided for allotment as transmission rates to each relay connection, and the allotted rates are reported
5 to the partner in establishing said new transport layer protocol.

30. A transport layer relay device according to claim 8, wherein, when establishing a transport layer connection with a terminal, initial transmission rate information is reported to the terminal that is reported from said transmission rate control unit.

5

31. A transport layer relay method according to claim 15, wherein, when establishing new transport layer connection, said total transmission rate

is determined and rates obtained by dividing said total transmission rate are reported to said partner in establishing a new transport layer protocol.

5

32. A transport layer relay device according to claim 22, wherein, when establishing a transport layer connection with a terminal, initial transmission rate information that is reported from said transmission rate control unit is reported to the terminal.

5

33. A program for causing a computer to function as:
a plurality of terminal-side connection termination units for terminating transport layer connections with a plurality of terminals on respective transport layers;

5

a plurality of interdevice connection termination units for both relaying transport layer data with each of said terminal-side connection termination units, terminating each of a plurality of transport layer connections between transport layer relay devices, and, when transmitting, transmitting in accordance with transmission rates that are reported from a transmission rate control unit; and

10

a transmission rate control unit for determining the total transmission rate of all interdevice connection termination units that are being used in relay, dividing said total transmission rate, and reporting rates that have been divided and allotted to each of said interdevice connection termination units that are being used in relay.

15

34. A program for causing a computer to function as:

a plurality of terminal-side connection termination units for terminating transport layer connections with terminals in the transport layer;
one interdevice connection termination unit for terminating transport layer connections between transport layer relay devices, and, during transmission, transmitting in accordance with a transmission rate that is reported from a transmission rate control unit;
a MUX-DEMUX unit for grouping, as one flow, transport layer data from each of said terminal-side connection termination units and transferring to said interdevice connection termination unit in accordance with the distribution of rates that is reported from the transmission rate control unit; and
a transmission rate control unit for determining and reporting the total transmission rate of said interdevice connection termination unit, and for reporting the distribution of rates obtained by dividing said total transmission rate to the MUX-DEMUX unit.